

Valve, in particular for a breast shield set

Technical field

5 The invention relates to a valve according to the preamble of patent claim 1. The valve is suitable in particular for use in a breast shield set. The invention further relates to a breast shield set for pumping off human breast milk according to the preamble
10 of patent claims 18 and 22.

Background

Breast shield sets are used together with breast pumps
15 for pumping off human breast milk. They usually comprise a breast shield with a breast shield funnel for placing on the human mother's breast, a first connector part for connection to a milk collection vessel, and a second connector part for attachment to a
20 mechanical or electrical pump or for attachment to a suction line of such a pump.

To pump off the breast milk, the breast shield funnel is placed as tightly as possible on the mother's
25 breast, and a vacuum is generated cyclically in the breast shield funnel by means of the pump. To keep the space to be evacuated as small as possible, i.e. to minimize the dead volume, the breast shield set has a nonreturn valve in the direction of the milk collection
30 vessel. This nonreturn valve is opened toward the interior of the milk collection vessel by means of the pressure of the aspirated milk and, when a vacuum is applied, closes said vessel off relative to the evacuated volume of the rest of the breast shield set.

35 The valve has a valve seat which is covered by a valve body in the form of a diaphragm flap secured at one end. When the milk flowing in is at sufficient pressure, the diaphragm flap is opened toward the

interior of the vessel. This valve has indeed proven effective in practice. However, such breast shield sets are relatively expensive to manufacture. Since the market increasingly requires that these breast shield sets should, for hygiene reasons, be used just once or at most only a few times, there is a need to reduce the manufacturing costs as much as possible.

Since these breast shield sets are therefore to be used only a few times at most, the individual parts should be able to be produced as inexpensively as possible. This applies also in particular to the nonreturn valve. Since, however, the breast shield set should be cleaned after each use, the valve must also be constructed as simply as possible and be correspondingly easy to clean. Moreover, it must not distort during cleaning, in order to subsequently ensure sufficient sealing. The shape, configuration and choice of material of the valve play an important role in achieving these objects. The breast shield sets are usually made from plastic, in particular polyethylene (PE), polypropylene (PP) or polycarbonate (PC), while the valve body itself is made of silicone.

Disclosure of the invention

It is therefore an object of the invention to make available a valve which can be produced inexpensively and which nevertheless permits a secure seal.

This object is achieved by a valve having the features of patent claim 1.

The valve according to the invention comprises a valve seat and a valve body with a circular diaphragm. The valve body is arranged over the valve seat in order to close the latter sealingly when it bears on the valve seat. The valve seat and the valve body have openings which are offset relative to one another and which form

a free passage when the diaphragm of the valve body lifts. The diaphragm of the valve body has elongate openings which are uniformly distributed along a circle in the periphery of the diaphragm, the circle preferably having approximately the same center point as the diaphragm. The elongate openings are arc-shaped, their longitudinal dimension extending along said circle. They are separated from one another by webs or bridges. In other words, the elongate openings form a common circular ring whose width is a multiple smaller than the smaller radius of the circular ring and which is provided with webs. The diaphragm is designed to be weaker in the area adjacent to these webs or bridges.

There are preferably exactly three such openings and exactly three webs, with the result that the diaphragm is held in a peripheral three-point suspension.

The weakened areas can be compact openings or thinned parts or preferably a combination of these. These weakened areas help to compensate stresses, such that the functionality of the valve is guaranteed even after it has been cleaned by heating.

Good results have been achieved with T-shaped compact openings.

The combination of thinned areas and compact openings has the advantage that the webs forming the valve articulation are sufficiently flexible, even after cleaning, to ensure that the diaphragm circle formed by the elongate openings is able to lift and fall sufficiently quickly.

A cylindrical jacket is preferably formed integrally on the diaphragm and is pushed over a collar of the valve seat. If the jacket has axially extending notches

and/or circumferential grooves on its inside face, distortion during cleaning is likewise avoided.

5 The described valve according to the invention, in the
aforementioned embodiments and also in embodiments
described below, is preferably used in breast shield
sets of the type mentioned in the introduction.
However, it can also be used in other articles, in
particular in medical products, for example for
10 drainage bags for aspiration of body fluids or in
suction lines of any kind.

It is therefore a further object of the invention to
make available a breast shield set that can be produced
15 as inexpensively as possible.

This object is achieved by a breast shield set having
the features of patent claim 18.

20 To satisfy the hygiene regulations for repeat use,
breast shield sets are usually able to be sterilized
and autoclaved. However, increased demands placed on
hygiene, both in hospital use and in private use, have
in recent times prompted a need for breast shield sets
25 that permit only a limited degree of repeat use. This
repeat use is normally limited to a single day.

It is therefore a further object of the invention to
make available a breast shield set that allows only a
30 limited degree of repeat use.

This object is achieved by a breast shield set having
the features of patent claim 22.

35 The breast shield set according to the invention has at
least one part that is not able to be autoclaved. It
suffices entirely if this is the valve body. If the
valve body is autoclaved, it distorts, and the
functionality of the whole breast shield set is no

longer guaranteed, because of lack of leaktightness and a consequent increase in dead volume.

5 It is also possible for several parts to be made from non-autoclavable material, for example the valve seat, the breast shield connector and the breast shield funnel. Of course, other accessories such as the suction line can be made from a non-autoclavable material.

10

The solution according to the invention results from the following observation:

15 Neonatal or maternity wards of hospitals are themselves normally able to clean the breast shield sets, so that the mothers can in each case reuse their own respective breast shield set. Moreover, the mothers or nursing staff are able to check how often the breast shield set has already been used, and it can be disposed of after
20 a suitably short time. Autoclavable breast shield sets are normally cleaned in another department, so that they have to leave the neonatal or maternity wards and often arrive back in the ward only the next day, and the aforementioned possibilities of verification are
25 therefore no longer afforded. If it is now possible to prevent the breast shield sets from being autoclaved, the desired limited degree of repeat use is possible.

30 However, the requirement that the valve body should no longer be able to be autoclaved means that the choice of material is greatly restricted. A thermoplastic elastomer (TPE) is suitable as the material. However, this material places considerable demands on the form of the valve body to ensure that it cannot distort
35 during cleaning. The valves according to patent claims 1 to 17 meet these demands.

Further advantageous embodiments are set forth in the dependent patent claims.

Brief description of the drawings

The subject of the invention is explained in more
5 detail below on the basis of preferred illustrative
embodiments depicted in the attached drawing, in which:

- Figure 1 shows a perspective view of the breast
shield set including the collection
10 vessel, suction line and closure lid;
- Figure 2 shows an exploded view of the breast
shield set according to Figure 1;
- 15 Figure 3 shows a perspective view of a breast
shield connector;
- Figure 4a shows a perspective view of a valve
seat;
20
- Figure 4b shows a further perspective view of the
valve seat according to Figure 4a;
- Figure 4c shows a side view of the valve seat
25 according to Figure 4a;
- Figure 4d shows a view of the valve seat according
to Figure 4a from above;
- 30 Figure 4e shows an enlarged cross section through
part of the valve seat according to
Figure 4a;
- Figure 5a shows a side view of a valve body;
35
- Figure 5b shows a view of the valve body according
to Figure 5a from above;

- Figure 5c shows a cross section through the valve body along A-A according to Figure 5b;
- 5 Figure 5d shows a view of the valve body according to Figure 5a from below;
- Figure 5e shows a perspective view of the valve body according to Figure 5a;
- 10 Figure 5f shows a further perspective view of the valve body according to Figure 5a;
- Figure 5g shows an enlarged detail P according to Figure 5b;
- 15 Figure 5h shows an enlarged detail Q according to Figure 5d;
- Figure 5i shows an enlarged detail X according to Figure 5c;
- 20 Figure 5k shows an enlarged detail Y according to Figure 5c;
- 25 Figure 6a shows a side view of a valve body according to a second embodiment;
- Figure 6b shows a cross section through the valve body according to Figure 6a, and
- 30 Figure 6c shows an enlarged detail according to Figure 6b.

Ways of implementing the invention

- 35 Figure 1 shows a breast shield set according to the invention. A breast shield connector 2 is screwed onto a milk collection vessel 1. A breast shield 3 with a breast shield funnel 30 is secured on one end of the

breast shield connector 2, and a suction line 4 is secured at the other end. Instead of the breast shield connector 2, a closure lid 5 can be screwed onto the milk collection vessel 1, for example when the
5 collection vessel 1 is filled.

Figure 2 shows how the individual aforementioned parts can be connected to one another. The collection vessel 1 has a neck 10 with an outer thread 11 onto which a
10 threaded attachment 20 with an inner thread 22 (Figure 3) of the breast shield connector 2 can be screwed. A connector piece 21 is formed integrally on this threaded attachment 20 via a short neck 24. The connector piece 21 has a receiver opening 25 into which
15 a coupler 31 of the breast shield 3 can be fitted. At the opposite end of the connector piece 21, a socket (not shown) is provided for direct attachment to the suction line 4. With the coupling piece 40, the tube 4 can be connected to an external breast pump.

20 The breast shield 3 can also be formed integrally on the breast shield connector 2. Moreover, the breast shield connector 2 can have, instead of the suction line socket, a receiver for a manual or electric motor.

25 As is also shown in Figure 2, a valve with a valve seat 6 and with a valve body 7 secured on the latter is present between the breast shield connector 2 and the collection vessel 1. This valve is preferably arranged
30 in the breast shield connector 2. The valve seat 6 can be formed integrally on the breast shield connector 2 or can be fitted onto a corresponding receiver 23. This corresponding valve receiver 23 in the form of an inwardly protruding neck can be seen in Figure 3.
35 Reference number 26 designates upper abutments for the milk collection vessel or breast milk bottle.

The valve seat 6 is shown in Figures 4a to 4e. It has a circular cover surface 61 which is substantially plane

or absolutely plane and, formed integrally thereon, a peripheral collar 60. In the cover surface 61, there is a central opening 64 and peripheral openings 65. The peripheral openings 65 preferably form a common circle
5 whose center point coincides with the center point of the circular cover surface 61. Exactly three peripheral openings 65 are preferably present, the common circle being interrupted by webs 66. As can best be seen from Figures 4c and 4e, the cover surface 61 protrudes from
10 the collar 60 with a circumferential edge 62. Moreover, the collar 60 has a circumferential bead 63 in the lower area remote from the cover surface 61. This part can also be inscribed. A suitable example is designated by reference number 67 in the figures.

15 The valve body 7 is shown in Figures 5a to 5k. This valve body 7 can be fitted over the above-described valve seat 6. The valve is held in the breast shield connector 2 with the bead 27 and preferably with the
20 first groove 77 or the second groove 78.

The valve body 7 has essentially the same basic shape as the valve seat 6, i.e. it has a circular, substantially plane diaphragm 70 which is surrounded by
25 a peripheral cylindrical jacket 75. The diaphragm 70, however, can also have knobs on its outside face directed away from the valve seat 6. The diaphragm 70 has areas 74 which are designed to be weaker. This weakening is obtained, on the one hand, by the fact
30 that these areas 74 have a smaller material thickness, as can be seen from Figure 5a. On the other hand, compact openings 73 are present. The thinner areas or recesses 74 preferably have a constantly increasing transition to the rest of the diaphragm. Figure 5a
35 shows that the edge areas of these areas 74 are designed as ramps. This can also be seen from Figure 5e.

As is shown in particular in Figure 5b, the diaphragm 70, except for a small number of openings 71, 73, is designed substantially as a closed surface connected to its jacket 75 and secured in a three-point suspension.

5 In particular, openings 71, 73 are present only in the peripheral area, not in the central area.

The diaphragm 70 shown has two types of openings 71, 73: narrow, elongate openings 71, and small, compact
10 openings 73.

The elongate openings 71 are arranged in the peripheral area along the circumference of the diaphragm 70. In the example shown, three openings 71 of equal length
15 and of equal size are present, each opening 71 extending by an angle of less than 120° . However, another number of openings can also be present. The openings 71 are, however, preferably arranged in a rotationally symmetrical manner in the peripheral area
20 of the diaphragm.

They form a common circle whose center point preferably coincides with the center point of the diaphragm 70 or cover surface. This circle is interrupted by webs 72 or
25 bridges. The smaller openings 73 are arranged in the area adjacent to these webs 72 and to the peripheral openings 71. One small compact opening 73 is preferably situated between each elongate opening 71. In this example, therefore, there are also three of these
30 compact openings 73. These openings 73 preferably have a T-shaped configuration, with a foot and with a bar extending transversely over the latter. The foot is oriented radially toward the webs and to the center point of the diaphragm 70, and the bar is directed
35 outward toward the periphery. The foot preferably ends on the outside of the circle formed by the peripheral openings 71. The bars of the individual openings 73 preferably lie on a circle whose center point coincides with the center point of the diaphragm. The bars are

preferably curved in accordance with this circle, as can be seen in Figure 5g.

5 The T-shaped openings 73 are located entirely within the weakened areas or recesses 74. However, the recesses 74 are slightly wider than the openings 73 themselves, at least in the area of the bars of said openings 73.

10 According to Figures 5c, 5i and 5k, the jacket 75 of the valve body 7 is preferably plane on its outside. The inner face of the valve body 7, however, has at least one, preferably two circumferential grooves 77, 78. Moreover, at least one notch 76 extending
15 transversely relative to the circumferential grooves 77, 78 and therefore parallel to a center axis of the cylinder is provided, as is shown in Figure 5f. This notch 76 preferably starts at the groove 78 lying nearer the diaphragm and ends on the outer edge of the
20 jacket 75. In the present example, three notches 76 are provided which are each located in the area of the T-shaped openings 73, preferably in the line defined by the foot. This can be seen from Figures 5d and 5h. The grooves 77, 78 and notches 76 help avoid distortion of
25 the jacket in the event of temperature changes, in particular during sterilization.

When the valve body 7 is arranged on the valve seat 6, as can be seen from comparison of Figures 4d and 5b,
30 the central opening 64 and the peripheral openings 65 of the valve seat 6 are covered by the circular diaphragm flap which is located inside the elongate openings 71. The elongate openings 71 and the compact openings 73, by contrast, lie on the outer edge area of
35 the valve seat 6. In this way, the valve is closed at normal pressure. If the pressure on the diaphragm flap is now increased, it curves uniformly toward the interior of the collection vessel 1 and frees the openings 64, 65 of the valve seat. By this means, the

openings 71, 73 of the valve body 7 also move away from their bearing surface, and passages are formed leading from one side of the valve to the other. When the pressure on the inside of the diaphragm subsides, the latter drops back onto the valve seat and closes the nonreturn valve.

The above-described individual parts of the breast shield set are preferably made from a sterilizable and autoclavable material, for example polypropylene (PP). However, at least one part, preferably the valve body, is made from a non-autoclavable material, for example a thermoplastic elastomer (TPE). It is preferable for only the valve body to be made from such a material.

Although the valve according to the invention has been described with reference to its use in a breast shield set, it can also be employed in other areas, for example in drainage bags or drainage containers for aspiration of body fluids, in vacuum hoses or in other medical or nonmedical devices.

Figures 6a to 6c show a second preferred embodiment of the valve body 7. It can be used together with the valve seat 6 described above. Except for an external bead 79, it has the same design as the above-described first illustrative embodiment of the valve body 7. This external bead 79 preferably extends about the entire circumference of the jacket 75. However, it can also be interrupted in places. It is also preferably arranged in the edge area of the jacket 75 adjacent to the diaphragm 70. By virtue of this bead 79, the valve body 7 can be more easily released from the valve seat 6 by hand, because the bead 79 improves the grip of the surface. A groove can also be used instead of or in addition to the bead 79. The jacket surface can likewise be provided with knobs, recesses or axially extending ribs.

The valve according to the invention is simple and inexpensive to manufacture, is reliable in its use, and scarcely deforms at all even in the case of considerable variations in temperature.

List of reference numbers

	1	milk collection vessel
5	10	neck
	11	thread
	2	breast shield connector
	20	threaded attachment
	21	connector piece
10	22	inner thread
	23	valve receiver
	24	neck
	25	receiver opening
	26	abutment
15	27	bead
	3	breast shield
	30	breast shield funnel
	31	coupler
	4	suction line
20	40	coupling piece
	5	closure lid
	6	valve seat
	60	collar
	61	cover surface
25	62	edge
	63	bead
	64	central opening
	65	peripheral opening
	66	web
30	67	inscription
	7	valve body
	70	diaphragm
	71	elongate opening
	72	web
35	73	compact opening
	74	recess
	75	jacket
	76	notch
	77	first groove

78 second groove
79 external bead